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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Docket No: Q85504

Heiji WATANABE et al.

Appln. No.: 10/519,084

Group Art Unit: Not yet assigned

Confirmation No.: Not yet assigned

Examiner: Not Yet Assigned

Filed: December 23, 2004

For: SEMICONDUCTOR DEVICE AND MANUFACTURING METHOD THEREOF

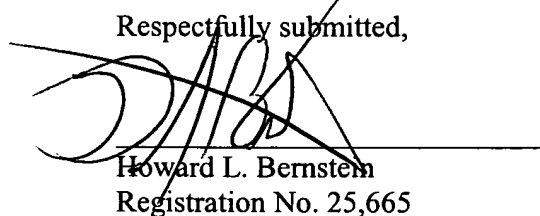
**SUBMISSION OF INTERNATIONAL PRELIMINARY
EXAMINATION REPORT (IPER)**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

For the Examiner's convenience, enclosed herewith is a copy of the English translation of the International Preliminary Examination Report (IPER). It is assumed that copies of the cited references as required by §371(c) will be supplied directly by the International Bureau, but if further copies are needed, the undersigned will undertake to provide them upon request.

Respectfully submitted,



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WASHINGTON OFFICE

23373

CUSTOMER NUMBER

Date: June 6, 2005

From the INTERNATIONAL BUREAU

PCT

**NOTIFICATION OF TRANSMITTAL
OF COPIES OF TRANSLATION
OF THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

(PCT Rule 72.2)

To:

MIYAZAKI, Teruo
8th Floor, 16th Kowa Bldg.
9-20, Akasaka 1-chome
Minato-ku, Tokyo 107-0052
JAPON



Date of mailing (day/month/year) 10 March 2005 (10.03.2005)	
Applicant's or agent's file reference NEC03P032	IMPORTANT NOTIFICATION
International application No. PCT/JP2003/007761	International filing date (day/month/year) 19 June 2003 (19.06.2003)
Applicant NEC CORPORATION et al	

1. Transmittal of the translation to the applicant.

The International Bureau transmits herewith a copy of the English translation made by the International Bureau of the international preliminary examination report established by the International Preliminary Examining Authority.

2. Transmittal of the copy of the translation to the elected Offices.

The International Bureau notifies the applicant that copies of that translation have been transmitted to the following elected Offices requiring such translation:

AZ, CA, CH, CN, CO, EP, GH, KG, KP, KR, MK, MZ, RO, RU, TM

The following elected Offices, having waived the requirement for such a transmittal at this time, will receive copies of that translation from the International Bureau only upon their request:

AE, AG, AL, AM, AP, AT, AU, BA, BB, BG, BR, BY, BZ, CR, CU, CZ, DE, DK, DM, DZ, EA, EC, EE, ES, FI, GB, GD, GE, GM, HR, HU, ID, IL, IN, IS, KE, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MN, MW, MX, NI, NO, NZ, OA, OM, PH, PL, PT, SC, SD, SE, SG, SK, SL, TJ, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW

3. Reminder regarding translation into (one of) the official language(s) of the elected Office(s).

The applicant is reminded that, where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report.

It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned (Rule 74.1). See Volume II of the PCT Applicant's Guide for further details.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer

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Translation

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

PCT Application
PCT/JP2003/007761



Applicant's or agent's file reference NEC03P032	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/JP2003/007761	International filing date (day/month/year) 19 June 2003 (19.06.2003)	Priority date (day/month/year) 27 June 2002 (27.06.2002)
International Patent Classification (IPC) or national classification and IPC H01L 29/78, 21/336		
Applicant NEC CORPORATION		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 10 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☒ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 19 June 2003 (19.06.2003)	Date of completion of this report 22 December 2003 (22.12.2003)
Name and mailing address of the IPEA/JP	Authorized officer
Facsimile No.	Telephone No.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/JP2003/007761

I. Basis of the report

1. With regard to the elements of the international application:*

☒ the international application as originally filed☐ the description:

pages _____, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

☐ the claims:

pages _____, as originally filed

pages _____, as amended (together with any statement under Article 19

pages _____, filed with the demand

pages _____, filed with the letter of _____

☐ the drawings:

pages _____, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

☐ the sequence listing part of the description:

pages _____, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).☐ the language of publication of the international application (under Rule 48.3(b)).☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.☐ filed together with the international application in computer readable form.☐ furnished subsequently to this Authority in written form.☐ furnished subsequently to this Authority in computer readable form.☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4. ☐ The amendments have resulted in the cancellation of:☐ the description, pages _____☐ the claims, Nos. _____☐ the drawings, sheets/fig _____5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rule 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

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IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.
- ☒ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.
- ☒ not complied with for the following reasons:

SEE SUPPLEMENTAL SHEET

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☒ all parts.
- ☐ the parts relating to claims Nos. _____

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Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: IV. 3.

There must be a special technical feature so linking a group of inventions of claims as to form a single general inventive concept in order that the group of inventions may satisfy the requirement of unity of invention. The inventions of claims 1 to 20 are linked only by the technical feature that a "gate insulating film" comprises a "metal silicate film."

However, it is clear, as mentioned in the "background art" of the description of this application, that this technical feature is well-known and cannot be a special technical feature. Therefore there is no special technical feature so linking the group of inventions of claims 1 to 20 as to form a single general inventive concept.

Consequently, it is obvious that the inventions set forth in claims 1-20 do not comply with the requirement of unity of invention.

Next, the number of inventions of the claims in the international application so linked as to form a single general inventive concept, namely, the number of inventions, will be examined. Considering the specific modes of the inventions of the claims, the claims of the international application define six inventions: the invention of claims 1-5, 8, 11-13, 16-19, the invention of claim 6, the invention of claims 7, 15, the invention of claim 9, the invention of claims 10, 14 and the invention of claim 20. From among the inventions, the inventions of claims 1-5, 8, 11-13, 16-19 and of claim 6 are linked only by the technical feature wherein "a gate insulating film" has "a structure in which nitrogen is introduced into a metal silicate." However, this

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Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: IV. 3.

technical feature is also well-known and cannot be a special technical feature, as mentioned in the "background art" of the description. Similarly, the relationship among claims 1-5, 8, 11-13, 16-19 and claims 10, 14, and the relationship among claim 6 and claims 10, 14 involve no special technical features. The inventions of claims 1-5, 8, 11-13, 16-19, claims 7, 15, claim 9, and claim 20 are linked by the technical feature that "the position where the nitrogen concentration is highest in the direction of film thickness is a region away from the silicon substrate", with respect to the technical feature that "a gate insulating film" includes a nitrogen-containing high dielectric constant insulating film having "a structure in which nitrogen is introduced into a metal silicate".

Consequently the number of inventions in this international application is three: (1) the invention of claims 1-5, 8, 11-13, 16-19, claims 7-15, claim 9, and claim 20; (2) the invention of claim 6; and (3) the invention of claims 10, 14.

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V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	4, 9, 10, 14, 16-19	YES
	Claims	1-3, 5-8, 11-13, 15, 20	NO
Inventive step (IS)	Claims	16-19	YES
	Claims	1-15, 20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims		NO

2. Citations and explanations

Document 1: H.-J. Cho et al., Novel Nitrogen Profile Engineering for Improved TaN/HfO₂/Si MOSFET Performance, International Electron Devices Meeting. Technical Digest 2001

Document 2: Hag-Ju Cho et al., Structural and Electrical Properties of HfO₂ With Top Nitrogen Incorporated Layer, IEEE Electron Device Letters, Vol. 23, No. 5, May 2002

Document 3: JP 2002-60944 A (International Business Machines Corporation), 28 February 2002

Document 4: JP 10-242461 A (Sony Corporation), 11 September 1998

Document 5: JP 2002-164343 A (Agere Systems Guardian Corporation), 7 June 2002

Document 6: US 6365467 B1 (Hyundai Electronics Industries Co., Ltd.), 2 April 2002

Claims 1 to 3 and 5

The invention set forth in claims 1 to 3 and 5 is disclosed in documents 1 to 3 cited in the international search report, and therefore lacks novelty and does not involve an inventive step.

Claim 4

The invention set forth in claim 4 does not involve an inventive step in the light of documents 1 to 4.

It would be easy for a person skilled in the art to apply the feature described in document 4, wherein the position in the film thickness direction at which the nitrogen concentration is the highest is localized within the central portion of the gate insulating film, to the gate insulating film set forth in documents 1 to 3.

Claims 6 to 8

The invention set forth in claims 6 to 8 is disclosed in document 3 (see paragraph [0102]) cited in the international search report, and therefore lacks novelty and does not involve an inventive step.

Moreover, the invention set forth in claim 8 does not involve an inventive step in the light of documents 1 to 3.

It would be easy for a person skilled in the art to apply the feature described in document 3, wherein a layer comprising a silicon oxide film is formed between a silicon substrate and a metal oxide film, which is a gate insulating film, to the gate insulating film set forth in documents 1 and 2.

Claim 9

The invention set forth in claim 9 does not involve an inventive step in the light of documents 1, 2, 3 and 5.

Documents 1 to 3 set forth a feature wherein nitrogen is introduced only to the upper part of a gate insulating film, in order to prevent boron penetration and to improve the interfacial characteristics of the gate insulating film.

Document 5 sets forth a gate insulating film comprising metal silicate, wherein the silicon

concentration reaches a minimum at the central part of the gate insulating film.

It would therefore be easy for a person skilled in the art to apply the feature described in documents 1 to 3, wherein nitrogen is introduced only to the upper part of a gate insulating film, to the gate insulating film set forth in document 5.

Claims 10 and 14

The invention set forth in claims 10 and 14 does not involve an inventive step in the light of documents 3 and 6.

Document 6 sets forth a three-layer structure as a gate insulating film, comprising a silicon nitride film, a metal oxide film and a silicon nitride film.

Document 3 sets forth a feature wherein a layer comprising a silicon oxide film is formed between a substrate and a metal oxide film, which is a gate insulating film.

It would therefore be easy for a person skilled in the art to apply the silicon oxide film described in document 3 as an alternative to the silicon nitride film formed as the lowermost layer of the gate insulating electrode described in document 6.

Claims 11 and 12

The invention set forth in claims 11 and 12 is disclosed in documents 1 to 3 cited in the international search report, and therefore lacks novelty and does not involve an inventive step.

In addition, documents 5 and 6 indicate that the material set forth in claims 11 and 12 is used, therefore the invention set forth in claims 11 and 12 does not involve an inventive step in the light of documents 1, 2, 3, 5 and 6.

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Claims 13 and 15

The invention set forth in claims 13 and 15 is disclosed in document 3 cited in the international search report, and therefore lacks novelty and does not involve an inventive step.

Moreover, the invention set forth in claim 13 does not involve an inventive step in the light of documents 1, 2, 3 and 5.

It would be easy for a person skilled in the art to apply the feature described in document 3, wherein the introduction of nitrogen is carried out by irradiation with nitrogen-containing plasma, to the inventions set forth in documents 1, 2 and 5.

Claims 16 to 19

The invention set forth in claims 16 to 19 is not disclosed in any of the documents cited in the international search report, and would not be obvious to a person skilled in the art.

Claim 20

The invention set forth in claim 20 is disclosed in documents 1 to 3 cited in the international search report, and therefore lacks novelty and does not involve an inventive step.

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VI. Certain documents cited

1. Certain published documents (Rule 70.10)

<u>Application No. Patent No.</u>	<u>Publication date (day/month/year)</u>	<u>Filing date (day/month/year)</u>	<u>Priority date (valid claim) (day/month/year)</u>
JP 2002-299607 A	11 October 2002 (11.10.2002)	28 March 2001 (28.03.2001)	
[EX]			

2. Non-written disclosures (Rule 70.9)

<u>Kind of non-written disclosure</u>	<u>Date of non-written disclosure (day/month/year)</u>	<u>Date of written disclosure referring to non-written disclosure (day/month/year)</u>